Measurements on the MI BPM Transitionboard

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Abstract

Writeup of measurements on the MI BPM Transitionboard.

Introduction

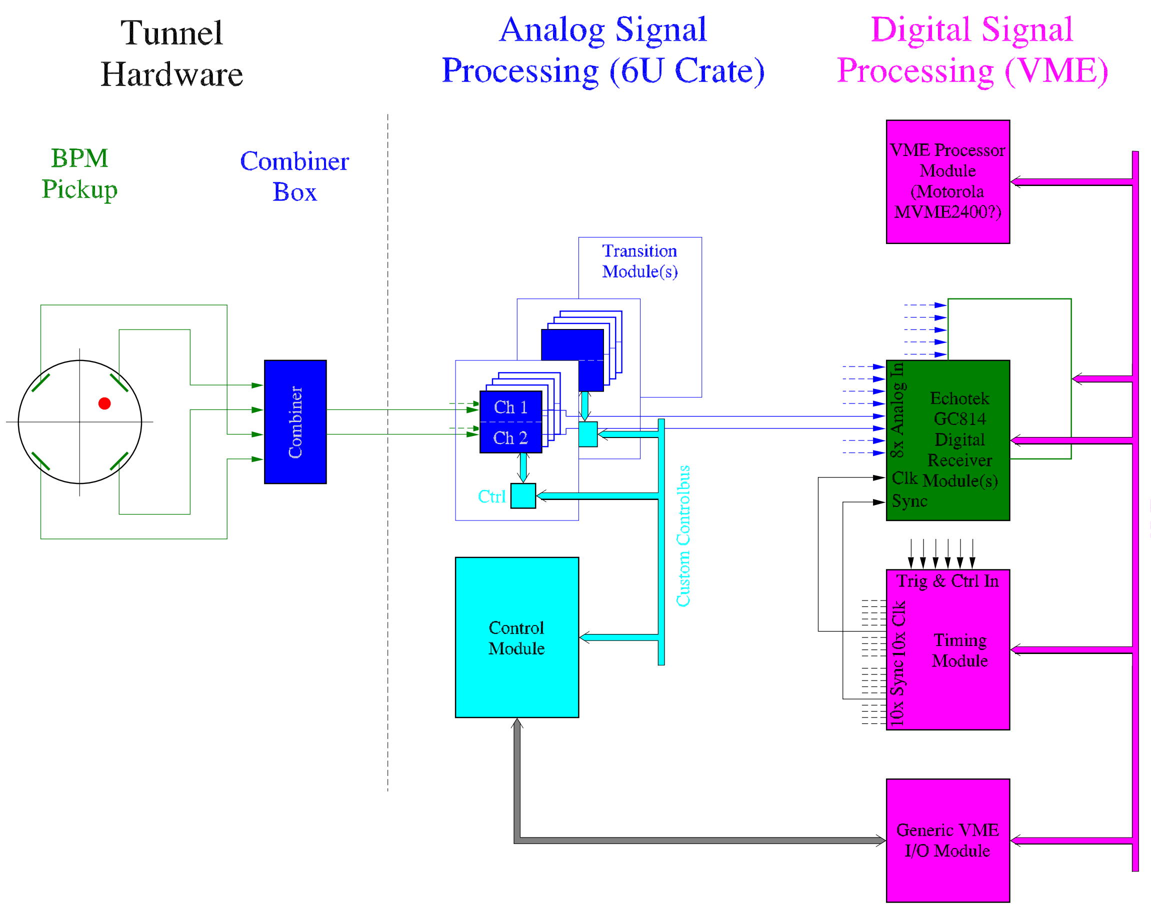


Figure 1: Overview of the MI BPM hardware.

Fig. 1 gives an overview of the MI BPM hardware. The *Transitionboard* (or *Transitionmodule*) interfaces the MI BPM pickup signals to the *Echotek* digitizer (digital receiver) module. It basically consists out of 2

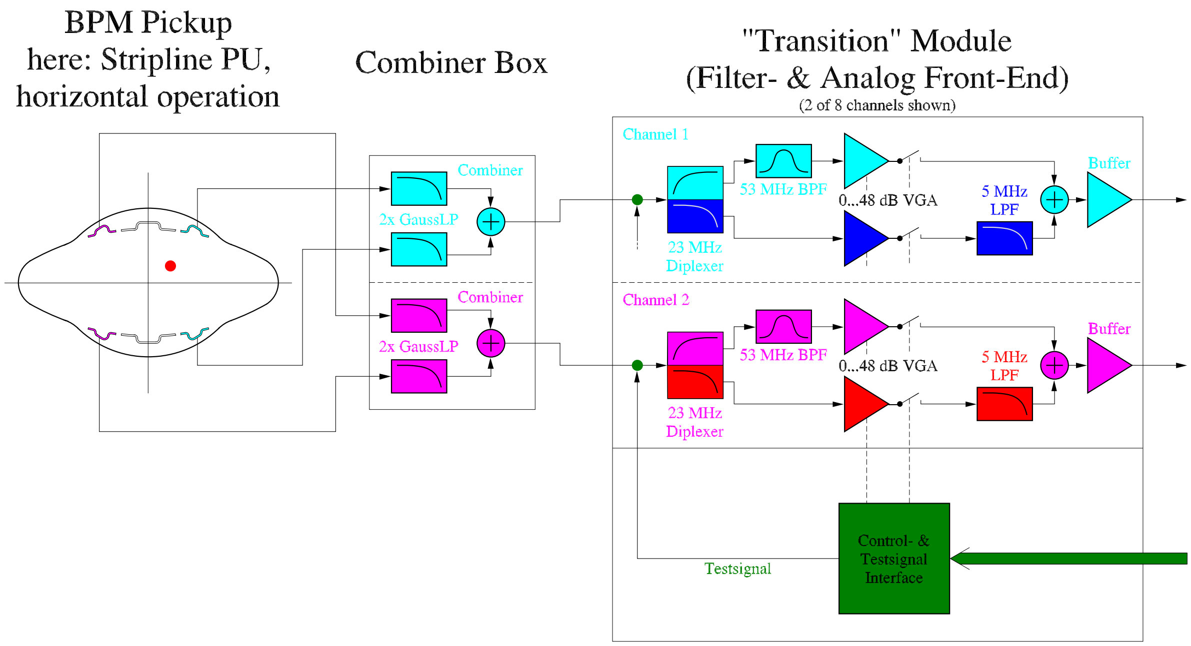


Figure 2: MI BPM analog hardware.

indepedent, selective gain stages per channel; one for 53 MHz, one for 2.5 MHz (see Fig. 2). The gain of a pair of stages can be controlled in a range 0...48 dB. The 6U high Transitionboard, currently in design, keeps a total of 8 channels, thus meets the input channel number of the corresponding *Echotek* digitizer module.

Transitionboard Prototype

A prototype Transitionboard, specified by the schematics (next page), was assembled. It was limited to 2 channels, with each a 52 Mhz and a 2.5 Mhz gain stage. All controls on this prototype are manual (i. e. jumpers, potentiometers), no test signal generation was implemented.

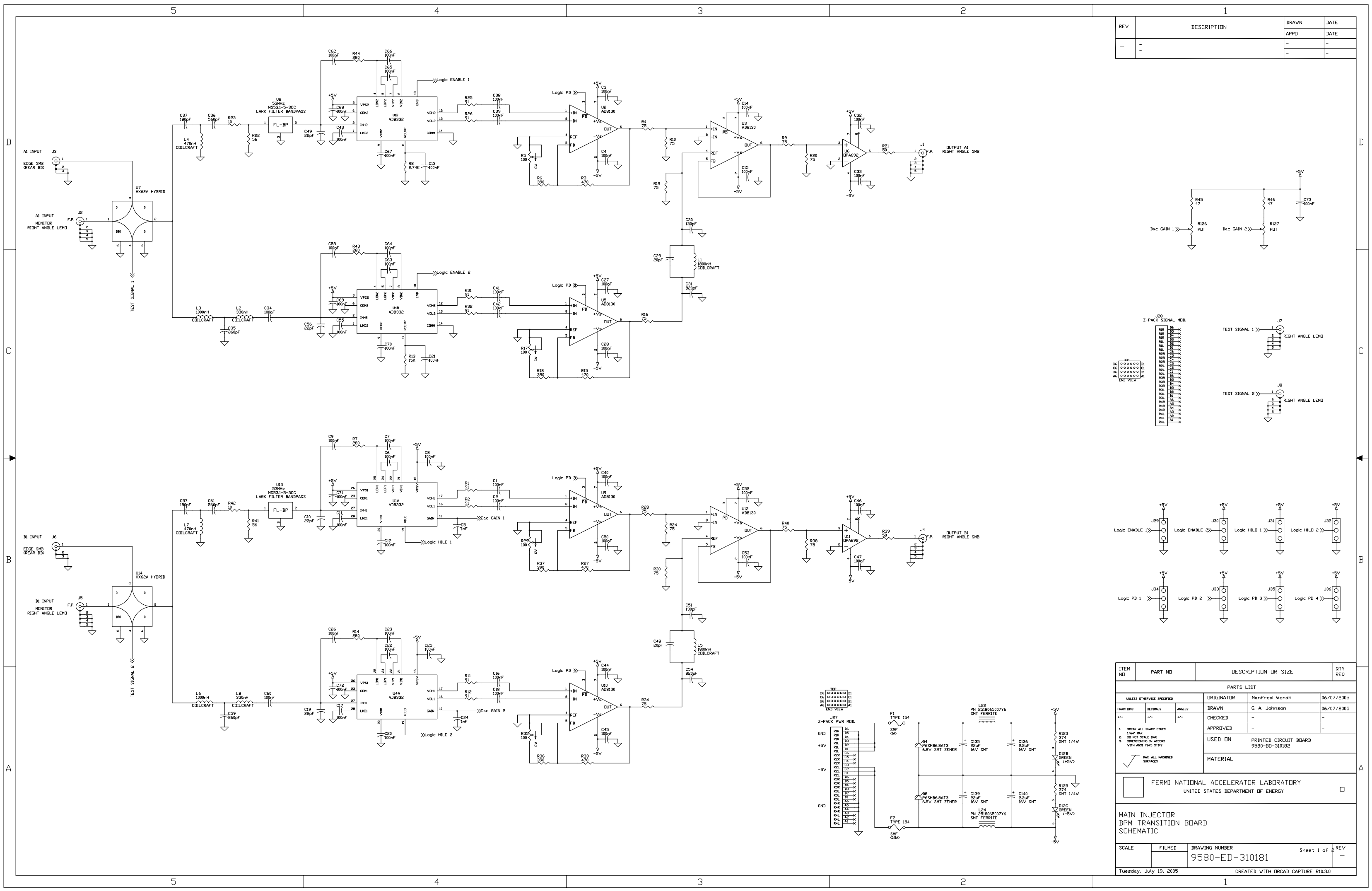
Commissioning and First Measurements of the 53 MHz Gain Stage

Due to a few missed parts (20 pF and 820 pF capacitors of the low-pass filter section in the 2.5 MHz gain stage) we assembled only a part of the prototype Transitionboard: one 53 Mhz gain stage. The following measurement procedure was applied:

- “Smoke” test.
- DC measurements.
- 53 MHz sinewave AC measurements.
- Swept frequency AC measurements ($|S_{21}|$ network-analyzer measurements).

The initial “smoke” test did not show any hard errors, i. e. the currents drawn by the circuit stay in the expected range.

We did a few DC measurements, checking the supply voltages and mid-voltages of the VGA (U1: AD8332). No surprises so far...


MAIN INJECTOR
BPM TRANSITION BOARD
SCHEMATIC
FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY
DRAWING NUMBER
9580-ED-310181
Sheet 1 of
ORIGINATOR Manfred Wendt 06/07/2005
DRAWN G. A. Johnson 06/07/2005
USED ON PRINTED CIRCUIT BOARD 9580-BD-310182
PARTS LIST
Tuesday, July 19, 2005
CREATED WITH ORCAD CAPTURE R10.3.0

We setup Scope with probe and AC (53 MHz) sinewave-generator. After resolving a problem of a grounded signal path (input pin of the 53 MHz BPF) we realized a fundamental problem with much too low overall gain. We found a design error at the input pins 1 and 8 of the differential receiver U2 (AD8130): Pulldown resistors where missed to discharge the 100 nF coupling capacitors C38 and C39. After adding two 10 kΩ pulldown resistors the 53 MHz gain stage basically meet the expected AC behaviour. The gains of the AD8332 VGA stages are a bit below the specs (total: -3 dB), so we decided to rais the gain of the following differential receiver (U2: AD8130). Changing R6 from 390 Ω to 280 Ω partially compensates that gain loss. Also much below specs (!) are the AD8332 output levels, each output saturates already at ≈ 1 V_{pp} (without clamping resistor!). So we decided to setup the circuit without clamping resistor (R8: 2.74 kΩ). With a TTl-level pulse generator we tested the behaviour of ENABLE (AD8332) and $\overline{\mathrm{PD}}$ (AD8130), to ON/OFF-switch the signal. The best operation was found by acting the $\overline{\mathrm{PD}}$-pin (AD8130) and tying ENABLE permanent to +5 V.
Switching times measured are: OFF → ON: ≈ 10 ns, ON → OFF: ≈ 100 ns.

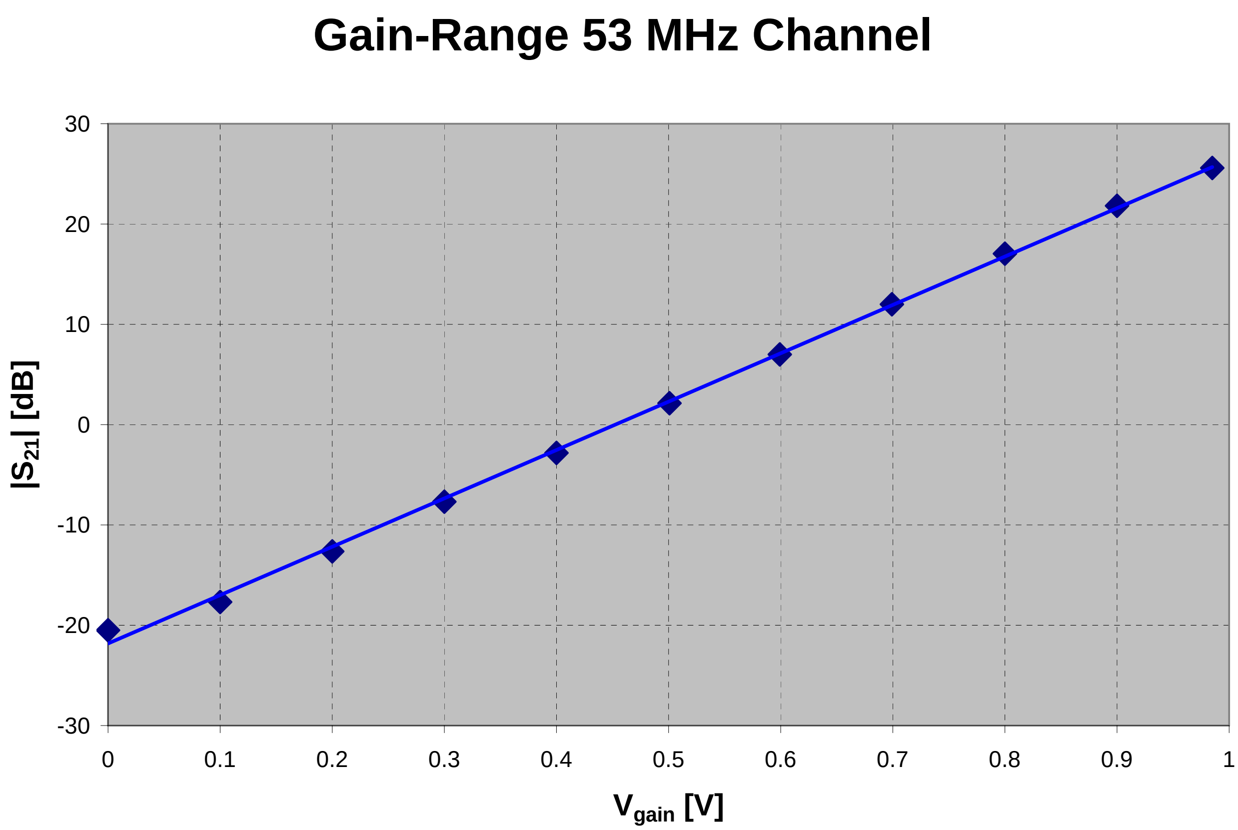


Figure 3: Gain-range of the 53 MHz channel, measured $|S_{21}|$ @ f = 53 MHz with -23 dBm input-port power.

Finally the swept frequency measurements were done with the network-analyzer. The circuit shows no surprises, the $|S_{21}(f)|$ shows the expected band-pass characteristic. Fig. 3 displays the measured gain-range of ≈ 45 dB, by varying the V_{gain} = 0...1 V at U1: Ad8332 pin 10. As in all these measurements, the HILO-pin was set to "LO", and the overall-gain (R5 potentiometer) was trimmed to the mid-value (50 Ω). The overall-gain adjustment, trimming R5 between 0...100 Ω, ranges 0.25 dB. The 1 dB comression output level is 5.8 dBm, measured with -18.8 dBm input-port power @ max. gain: $25.6 - 1 = 24.6$ dB. This corresponds to V_{out}= 435 mV_{RMS} (≡ 1.23 V_{pp}). The isolation of the 53 MHz channel in "OFF"-position was measured to 75 dB, by setting the $\overline{\mathrm{PD}}$-pin 3 of U2 (AD8130) to Gnd.